Injury, Int. J. Care Injured 47 (2016) 1345–1352

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Oral health-related quality of life in Iranian patients with spinal cord injury: A case–control study

Amir H. Pakpour [a,*], Santhosh Kumar [b], Janneke F.M. Scheerman [c,d], Chung-Ying Lin [e], Bengt Fridlund [f], Henrik Jansson [g]

[a] Social Determinants of Health Research Center, Qazvin University of Medical Sciences, Shahid Bahounar BLV, Qazvin 3419759811, Iran
[b] Population Social Health Research Program, Griffith Health Institute & School of Dentistry and Oral Health, Griffith University, Gold Coast, Australia
[c] Academic Centre of Dentistry Amsterdam, Department of Preventive Dentistry, ACTA University, Gustav Mahlerlaan 3004, 1081 LA Amsterdam, The Netherlands
[d] Oral Hygiene, Department of Health, Sports & Welfare, Inholland University of Applied Sciences, Amsterdam, The Netherlands
[e] Department of Rehabilitation Sciences, Faculty of Health & Social Sciences, The Hong Kong Polytechnic University, Hung Hom, Hong Kong
[f] School of Health Sciences, Jönköping University, Jönköping, Sweden
[g] Center for Oral Health, Department of Natural Science and Biomedicine, School of Health Sciences, Jönköping University, Jönköping, Sweden

ARTICLE INFO

Article history:
Accepted 16 March 2016

Keywords:
Iran
Oral health
Oral health-related quality of life
Predictors
Spinal cord injury

ABSTRACT

Introduction: The study aimed to compare the oral health variables, general, and oral health-related quality of life (QoL), depression, and anxiety between spinal cord injury (SCI) patients and healthy controls and also to determine the key factors related to the oral health-related quality of life (OHRQoL) in the SCI patients.

Methods: A total of 203 SCI patients and 203 healthy controls were enrolled. Patients and healthy adults were invited to attend a dental clinic to complete the study measures and undergo oral clinical examinations. OHRQoL was assessed by the 14-item Oral Health Impact Profile (OHIP-14), and the general health-related quality of life (GHRQoL) was evaluated by SF-36. In SCI patients, depression and anxiety were recorded using the Hospital Anxiety and Depression Scale (HADS), while Functional Assessment Measure (FAM) was used to assess dependence and disability. All the subjects were examined for caries which was quantified using the decayed, missing, and filled Teeth (DMFT) index, gingival bleeding index (GI), plaque index, and periodontal status by community periodontal index (CPI).

Results: The analysis of covariance (ANCOVA) revealed significant differences between the two groups in terms of oral health expressed in DMFT, oral hygiene, and periodontal status, controlled for age, gender, family income, and occupational status ($p < 0.001$). Using the hierarchical linear regression analyses, in the final model, which accounted for 18% of the total variance ($F(126.7)$, $p < 0.01$), significant predictors of OHRQoL were irregular tooth brushing ($\beta = 1.23$; 95% CI = 1.06; 1.41), smoking ($\beta = 0.82$; 95% CI = 0.66; 0.97), dry mouth ($\beta = 0.37$; 95% CI = −0.65 to 0.10) functional and motor functioning ($\beta = 0.32$; 95% CI = −0.45 to 0.17), DMFT ($\beta = 0.06$; 95% CI = 0.02; 0.09), CPI ($\beta = 0.22$; 95% CI = 0.04; 0.04), physical component measure of GHRQoL ($\beta = -0.275$; 95% CI = −0.42 to 0.13), lesion level at the lumbar–sacral ($\beta = -0.18$; 95% CI = −0.29 to −0.06) and thoracic level ($\beta = -0.09$; 95% CI = −0.11 to −0.06).

Conclusion: SCI patients had poor oral hygiene practices, greater levels of plaque, gingival bleeding, and caries experience than the healthy controls. In addition, more number of SCI patients had periodontal pockets and dry mouth than the comparative group. SCI patients experienced more depression and anxiety, poor GHRQoL, and OHRQoL than the healthy control group. The factors that influenced OHRQoL in SCI patients were age, toothbrushing frequency, smoking, oral clinical status, depression, physical component of GHRQoL, and level of lesion.

Introduction

The increasing prevalence of spinal cord injuries (SCI) is evidenced by the data from a recent systematic review reporting an incidence of 8–246 cases/million and 236–1298/million

* Corresponding author. Tel.: +98 2833239259; fax: +98 2833239259.
E-mail addresses: Pakpour_Amir@yahoo.com, apakpour@qums.ac.ir (A.H. Pakpour).

http://dx.doi.org/10.1016/j.injury.2016.03.022
0020–1383/

inhabitants globally [1]. Traumatic SCI contributes to a major proportion of SCI with the incidence ranging from 3.6 to 195.4 patients per million around the world [2]. The estimated prevalence of SCI in Iran is 348.45 cases per million individuals [3]. In Tehran province, the prevalence of SCI is found to be 296.87 per million based on the data obtained from three organisations that supports SCI patients [3], while another cross-sectional survey from Tehran city reports a point prevalence of 4.4 per 10,000 people in Tehran (i.e., ~440 per million) [4]. The burden of SCI and its aetiology varies between the countries and regions with this condition assumed to be more prevalent in developing than in developed countries [5]. In the developing countries, motor vehicle accidents and falls are the predominant causes for SCI [6] as is the case with Iran where trauma is the etiological factor for more than half of the SCI cases [7].

Mortality rates are high in those with SCI than the able bodied, which might be due to the associated urological, cardiovascular, or pulmonary disorders [8,9]. However, there has been considerable improvement in the survival of these patients in the recent decades owing to the improvements in medical care [8,9]. With the increase in survival, SCI is associated with secondary health conditions such as pressure ulcers, spasticity, upper-extremity pain, and obesity which can impede normal lifestyle and thus affect negatively the quality of life (QoL) [10]. The other psychosocial problems experienced by SCI patients are financial hardship due to unemployment, difficulties with transportation, education, marriage, social relationships, sports and entertainments, depression, sadness, suicidal thoughts, and lack of self-confidence [11]. Therefore, SCI is associated with not only limited function but also psychosocial and socioeconomic sequelae [12].

Most of the patients with SCI perceive a low QoL due to secondary health problems, dependence on others, and limitation in movement [13]. Limited movement and dependence on caregivers hinder the performance of regular general hygiene and also oral hygiene in SCI patients. Firstly, the medications usually prescribed in these patients to treat muscle spasms and neurogenic bladder disorders might lead to xerostomia which in turn leads to increased accumulation of dental plaque and also dental caries [14]. Secondly, these patients might restrain themselves from performing regular oral hygiene as this needs extra efforts and specialised equipment such as arm supports, universal cuffs, or splints [16]; a study by Stiefel et al. reported poor oral hygiene practices in these patients [17]. The research on the oral health status of SCI is scarce and there are no reports from Iran. Further, no studies have evaluated the oral health-related quality of life (OHRQoL) and its predictors in these patients, while extensive data are available on the general health-related quality of life (GHRQoL). This study aims (1) to compare the oral health variables, GHRQoL, OHRQoL, depression, and anxiety between SCI patients and healthy controls and (2) to investigate the key factors related to OHRQoL in SCI patients.

Materials and methods

Patients

In this case–control study, 203 SCI patients and 203 healthy controls were enrolled. The study was conducted in two neurologic centres of Qazvin University of Medical Sciences. SCI patients and healthy controls were recruited consecutively between February and July 2014.

Subjects were included in the patient group if they had SCI for >3 months, were aged ≥18 years, and agreed to participate in the study. Patients were excluded from the study if they were pregnant and severe psychotic, drug, or alcohol abusers or had communication difficulties and cognitive impairment as measured by the mini-mental state examination.

The controls were Qazvin residents randomly selected from health centres during the same period. In Iran, health-care and public health services are provided through nation-wide networks. Health centres are in charge of providing health services in their catchment areas. Health centres keep vital health information of the population from their catchment areas. A gender-, age-, and location-matched sample of healthy adults was identified from the records of the health centres. Eligible adults were approached by either telephone or personally at the health centres with written information about the study and were requested to participate in the study. Patients and healthy adults were invited to attend a dental clinic for completing the study measures and undergoing oral clinical examinations.

The study protocol was approved by the Research Ethics Committee of Qazvin University of Medical Sciences (QUMS), and all participants gave their written informed consents.

Measures

Sociodemographic and clinical data

Sociodemographic data such as age, gender, marital status, family income, and occupational status were collected. Clinical data on the lesion level, the aetiology of the SCI, time since injury, medication status, and the ability to perform hand-to-mouth activities were derived from patients' files.

Dry mouth

A single item was used to measure participant's experience of oral dryness. A dichotomous response (yes/no) was used to record dry mouth [18].

Dependence and disability

In order to evaluate dependency and disability in SCI patients, a trained neurologist completed the functional independence measure and the Functional Assessment Measure (FIM + FAM) [19] for each patient. The FIM has 18 items, including motor (13 items) and cognitive (five items) dimensions. All items are rated on a seven-point Likert-type scale that ranged from 1 (totally dependent) to 7 (completely independent), with higher scores indicating higher independency. The FAM has 12 items mainly covering the cognitive domain (nine items) and three items covering the motor domain. The FIM and FAM were unified in the UK version and produced UK FIM + FAM [19]. This 30-item FIM + FAM has been translated into several languages including Farsi [20], and this Iranian version of the FIM + FAM was found to be highly valid and reliable [20].

OHRQoL

OHRQoL was assessed using the oral health impact profile (OHIP-14) which consists of 14 questions assessing the perceived impact of oral health on daily living [21] in patients and healthy controls. The items in OHIP-14 are summarised into seven domains (two items per domain) which comprise functional limitation, psychological discomfort, physical disability, psychological disability, mental disability, social disability, and handicap. All responses are rated on a five-point Likert scale ranging from 0 (never) to 4 (very often/every day). The total score of OHIP-14 was obtained by summing up the response scores and ranged from 0 to 56, with high score indicating poor OHRQoL [21]. The Iranian version of the OHIP-14 reported good reliability, validity, and precision [22].

GHRQoL

The Short Form Health Survey (SF-36) was used to assess GHRQoL [23] in both groups. The SF-36 is a well-known generic QoL measure. It comprises 36 questions that cover eight subscales including physical functioning (PF), role limitations due to physical health (RP), body pain (BP), general health perception (GH), social functioning (SF), role limitations due to emotional problems (RE), vitality (VT), and mental health (MH). The eight categories can be summarised into two domains: Physical Component Summary (PCS) and Mental Component Summary (MCS). Scores in each component ranged from 0 to 100, with higher score indicating better GHRQoL. Satisfactory psychometric properties of SF-36 are well-documented in several countries including Iran [24].

Anxiety and depression

Hospital Anxiety and Depression Scale (HADS) was used to evaluate anxiety and depression [25] in patients and controls. The HADS has 14 items with seven items belonging to each subscale of depression and anxiety. Each item is rated on a four-point Likert scale ranging from 0 to 3 giving maximum and minimum scores of 0 and 21, respectively, for each subscale. More the depression or anxiety, greater is the summary score. HADS has been translated into many languages including Persian, and the Iranian version of the HADS had good acceptability, reliability, and validity [26].

Oral health behaviours

Data on frequency of toothbrushing and dental flossing, usage of mouthwash, and smoking status were collected from all the participants. Toothbrushing frequency was assessed using the question "How often do you brush teeth?" with the following responses: 1 = never, 2 = less than once in a month, 3 = once in a month, 4 = less than once a week, 5 = once a week, 6 = once a day and 7 = twice or more a day. A single measure "How often do you floss teeth?" was also used to assess the frequency of flossing the teeth with the following options to choose from: 1 = never, 2 = less than a month, 3 = once in a month, 4 = less than once a week, 5 = once a week and 6 = once or more a day. Daily use of mouth rinse was assessed by a single item "I use mouth rinse with fluoride or fluoride tablets every day" by a dichotomous response of yes or no [27]. The current smoking status was recorded, and we defined current smokers as those who smoked every day or some days and nonsmokers as those who never smoked or had smoked in the past but not now.

Clinical oral examination

Oral examinations were performed by two trained and calibrated dentists in a dental clinic using CPI (Community Periodontal Index) probe and dental mirrors. To calibrate the dentists for performing oral clinical examinations, 20 SCI patients were selected to be examined twice by the same dentists with an interval of 24 h apart. Furthermore, the inter-examiner reliability was conducted on the same 20 SCI patients. The two dentists independently scored the patients and were mutually blinded to each scoring. The agreement between the examiners was assessed using the intra-class correlation coefficient (ICC) with a two-way mixed-effects model. The results indicated that ICCs were 0.93, 0.86, 0.82, and 0.81 for decayed, missing, and filled teeth (DMFT) index, gingival index (GI), CPI, and visual plaque index (VPI), respectively. The ICC values of intrarater reliability for DMFT, GI, CPI, and VPI were 0.96, 0.90, 0.92, and 0.89, respectively. Dental caries was quantified using DMFT [28] index and was diagnosed using the World Health Organization (WHO) criteria [29]. The missing teeth component of DMFT includes only teeth that are missing due to caries and also badly decayed teeth that they are indicated for extraction, while filled teeth consists of only those teeth that have sound permanent restorations [28]. Dental plaque was measured using the modified VPI [30]. This index is based on a six-point scale ranging from 0 (no plaque) to 5 (plaque covering two-thirds or more of the crown of the tooth) with two scores assigned to each tooth, one for facial and the other for oral surface. Loe and Silness GI [31] and CPI [29] were used to evaluate the periodontal status. For GI, four surfaces of each tooth are scored on a four-point scale (0 = normal gingival; 1 = mild inflammation, slight change in colour, slight oedema, and no bleeding on palpation; 2 = moderate inflammation, redness, oedema, glasing, and bleeding on palpation; 3 = severe inflammation, marked redness and oedema, ulceration, and tendency to spontaneous bleeding). For scoring CPI, the mouth is divided into six sextants. Each sextant is given a score ranging from 0 to 4 (0 = healthy gingiva; 1 = bleeding on probing; 2 = calculus; 3 = pocket of 4–5 mm; and 4 = pocket of 6 mm or more) and a sextant is considered as missing "X" when less than two teeth are present in the sextant. The highest score of the CPI among all the six sextants was considered as the subject's final CPI score.

Statistical analysis

Statistical analyses were performed using SPSS software, Version 18 (SPSS, Chicago, IL, USA). Descriptive statistics were used to describe demographic and clinical data, including frequencies, means, and standard deviations. Sociodemographic characteristics between the groups were compared by independent *t*-test (for continuous variables) and chi-squared test (for categorical variables). Shapiro–Wilk test of normality was used to assess the assumption of normality. Comparisons of the oral health parameters, SF-36, OHIP-14, depression, and anxiety between SCI patients and healthy controls were evaluated using an analysis of covariance (ANCOVA) adjusted for age, gender, family income, and occupational status. The magnitude of the group differences was measured using the effect size [32]. Values of 0.2, 0.5, and >0.8 were considered as small, moderate, and large effect sizes, respectively [32]. In addition, *p*-values were adjusted for multiple comparisons according to the Benjamini and Hochberg procedure [33].

Univariate regression (forced-entry method) analysis was used to identify independent predictors of the OHRQoL. Variables that resulted in a *p*-value <0.2 in the univariate analysis were included in the multivariate regression analysis. Afterward, hierarchical linear regression analysis was used to further explore the effects of various factors on OHRQoL in SCI patients. At step 1, socio-demographic characteristics and clinical variables (age, gender, years of education, time after injury, FIM + FAM score, lesion level, dry mouth, DMFT, CPI, VPI, and GI) were included in the model. Next, oral self-care behaviours including tooth brushing, flossing, mouth rinse use, and smoking behaviours were added to the previous variables, resulting in model 2. At final step, GHRQoL, depression, and anxiety were additionally included. Associations were expressed as regression coefficients (β) with 95% confidence intervals (CI). *p*-Values <0.05 were considered as statistically significant. Assumptions of normality and linearity were tested for each variable. Because the distribution of the 14-item OHIP total score was slightly skewed (skewness = 0.17), a square root transformation was performed to normalise the data. Results from analyses using untransformed and transformed data were similar. For ease of comprehension, we reported results using the untransformed data. The presence of high correlations between independent variables (i.e., multicollinearity) was checked using tolerance and the variance inflation factor (VIF). A tolerance of <0.20 and a VIF of ≥ 5 indicate the problem of multicollinearity.

Results

The study sample included 203 SCI patients with a mean age of 58.6 (standard deviation; SD = 10.4) years and 203 healthy controls with a mean age of 58.0 (SD = 10.9) years. Table 1 presents the characteristics of the study sample, in which the demographics and clinical features of SCI patients were compared with the healthy controls. No significant differences were observed between the SCI patients and their correspondent controls in terms of age and gender. However, as compared with the healthy controls, SCI patients had significantly lower income, were more likely to be unemployed, experienced more of a dry mouth, used less quantities of mouthwash less, and brushed and flossed their teeth less frequently (Table 1).

Table 2 presents comparisons of oral health variables of the SCI patients with healthy controls. The results in Table 2 indicate that all the oral health variables differed significantly between the two groups ($p < 0.05$). For caries, SCI patients exhibited significantly higher DMFT scores than the healthy individuals (mean $\pm$ SD = 17.2 $\pm$ 8.7 vs. 9.9 $\pm$ 5.8; $F = 53.5$, $d = 1.0$, $p < 0.001$). Except for the decayed teeth, SCI patients had greater number of missing and filled teeth when compared to the healthy individuals. With respect to periodontal status, CPI scores 0, 1 and 2, indicating no pocket formation, were mainly found in the healthy controls, while CPI3 and CPI 4, denoting pocket formation, were predominantly found in the SCI patients. Furthermore, periodontal health as assessed by GI was poorer in SCI patients compared to the healthy controls ($F = 35.2$, $d = 0.8$; $p < 0.001$). In addition, the mean score of dental plaque of SCI patients was significantly higher than the healthy controls ($F = 115.2$, $d = 0.8$; $p < 0.001$).

GHRQoL in SCI patients and healthy controls was compared using ANCOVA (Table 3). All SF-36 subscale scores were significantly ($p < 0.01$) lower in SCI patients compared to the healthy controls (Table 3). Medium to large effect sizes were noted on most of the subscales, thus suggesting clinically meaningful differences between the groups. Significant differences were observed between SCI patients and healthy controls for overall OHIP-14 and subscale scores.

Table 4 presents the results of the hierarchical regression analysis, which were performed in order to determine the predictors of OHRQoL in SCI patients. No multicollinearity was reported between independent variables. The results indicated that sociodemographic and clinical variables together accounted for 39% of the variance. Model 2 reveals that oral self-care behaviours together accounted for 26% of the variance, and Model 3 indicates that GHRQoL, depression, and anxiety together accounted for 18% of the total variance. As a result, all independent variables in the final model (Model 3) together explained 82.2% of the variance ($F(126.7)$, $p < 0.01$). In addition, the significant predictors of OHRQoL were age ($\beta = 0.024$; 95% CI = 0.12–0.04), dependence and disability ($\beta = 0.31$; 95% CI = −0.45 to 0.17), paraplegia ($\beta = -0.89$; 95% CI = −0.11 to 0.06), dry mouth

Table 1
Sociodemographic characteristics and clinical variables of spinal cord injury (SCI) patients and healthy controls.

Variables	Mean $\pm$ SD or *n* (%)		*p*-Value
	SCI patients (*n* = 203)	Healthy controls (*n* = 203)	
Age; years	58.6 $\pm$ 10.4	58.0 $\pm$ 10.9	0.81
Gender			1.0
Male	164 (80.8%)	164 (80.8%)	
Female	39 (18.2%)	39 (18.2%)	
Marital status			0.32
Single	82 (40.4%)	79 (38.9%)	
Married	95 (46.8%)	107 (52.7%)	
Divorced/widowed	26 (12.8%)	17 (8.4%)	
Family income			<0.01
Good	31 (15.3%)	43 (21.2%)	
Moderate	108 (53.2%)	128 (63.1%)	
Poor	64 (31.5%)	32 (15.8%)	
Occupational status			<0.01
Employed	56 (27.6%)	104 (65.0%)	
Unemployed	147 (72.4%)	99 (48.8%)	
Smoking status			
Current smoker	164 (80.8%)	167 (82.3%)	0.72
Nonsmoker	39 (19.2%)	36 (17.7%)	
Years of education	7.49 $\pm$ 4.4	7.83 $\pm$ 5.2	0.41
Time after injury; months	45.80 $\pm$ 28.1	NA	
FIM + FAM domains			
Motor	79.7 $\pm$ 20.8	NA	
Cognitive	93.3 $\pm$ 7.4	NA	
Total score	173.2 $\pm$ 22.7	NA	
Lesion level			
Tetraplegia	68 (33.5%)	NA	
Paraplegia	135 (66.5%)	NA	
Taking medication			
Yes	186 (91.6%)	NA	
No	17 (8.4%)	NA	
Hand-to-mouth ability			
Able	182 (89.7%)	NA	
Unable	21 (10.3%)	NA	
Daily oral habits			
Brushing at least once or more	105 (51.7%)	164 (80.8%)	<0.01
Flossing at least once	60 (29.6%)	125 (61.6%)	<0.01
Mouth rinse	26 (12.8%)	45 (22.2%)	0.02
Dry mouth			
Yes	123 (60.6%)	59 (29.1%)	<0.01
No	80 (39.4%)	144 (70.9%)	

NA – not applicable. FIM + FAM – functional independence measure + functional assessment measure.

Table 2
Comparisons of oral health variables between spinal cord injury (SCI) patients ($n = 203$) and healthy controls ($n = 203$).

	SCI patients Mean (SD)	Healthy control Mean (SD)	F (p)	Effect size
Decayed teeth (DT)	2.3 (1.9)	3.8 (2.6)	4.7 (0.03)	0.6
Missing teeth (MT)	9.9 (5.9)	4.2 (1.4)	36.5 (<0.001)	1.3
Filled teeth (FT)	4.4 (1.2)	1.8 (1.0)	96.9 (<0.001)	2.3
Decayed missing and filledteeth (DMFT)	17.2 (8.7)	9.9 (5.8)	53.5 (<0.001)	1.0
Gingival index	1.5 (0.7)	1.0 (0.5)	35.2 (<0.001)	0.8
Plaque index	2.0 (0.9)	1.3 (0.8)	115.2 (<0.001)	0.8
Community periodontal index (CPI)				
	n (%)			n (%)
CPI0	8 (3.9%)			18 (8.9%)
CPI1	26 (12.8%)			38 (18.7%)
CPI2	51 (25.1%)			78 (38.4%)
CPI3	65 (32.0%)			48 (23.6%)
CPI4	44 (21.7%)			16 (7.9%)
CPIX	9 (4.4%)			5 (2.5%)

Table 3
Comparisons of general health-related quality of life (SF-36), oral health-related quality of life (OHIP-14), depression, and anxiety between spinal cord injury (SCI) patients ($n = 203$) and healthy controls ($n = 203$).

	SCI patients Mean (SD)	Healthy sample Mean (SD)	Effect size
SF-36 domains			
Physical functioning	24.8 (12.2)	83.4 (23.4)	3.1
Role limitations due to physical health	34.1 (16.2)	82.7 (37.9)	1.7
Bodily pain	50.3 (14.8)	76.2 (25.6)	1.2
General health	49.6 (15.7)	72.5 (24.5)	1.1
Vitality	53.7 (16.8)	68.6 (22.7)	0.7
Social functioning	63.3 (24.8)	71.3 (16.6)	0.4
Role limitations due to emotional problems	72.7 (27.8)	54.4 (21.3)	0.7
Mental health	47.3 (14.8)	69.8 (19.6)	1.3
Physical component summary; PCS	43.7 (14.1)	79.9 (24.7)	1.8
Mental component summary; MCS	62.2 (18.3)	71.1 (20.4)	0.5
OHIP-14 domains			
Functional limitation	3.2 (2.1)	1.3 (1.0)	1.2
Physical pain	3.8 (2.0)	1.9 (1.2)	1.2
Psychological discomfort	2.8 (2.2)	0.4 (0.8)	1.5
Physical disability	3.9 (2.8)	1.6 (1.1)	1.1
Mental disability	1.9 (1.4)	0.5 (0.7)	1.3
Social disability	1.5 (1.0)	0.3 (0.5)	1.6
Handicap	2.3 (1.4)	0.4 (0.8)	1.7
Overall	19.9 (12.7)	6.9 (3.8)	1.4
HADS subscale			
Anxiety	8.4 (3.7)	4.6 (3.1)	1.1
Depression	7.9 (3.5)	4.2 (3.3)	1.1

SF-36 – Short Form Health Survey; OHIP-14 – Oral Health Impact Profile; HADS – Hospital Anxiety and Depression Scale.
Note: All p-values <0.001.

($\beta = 0.37$; 95% CI = −0.65 to 0.10), DMFT ($\beta = 0.06$; 95% CI = 0.02; 0.09), CPI ($\beta = .22$; 95% CI = 0.04; 0.04), less frequent toothbrushing ($\beta = 1.23$; 95% CI = 1.06; 1.41), smoking ($\beta = 0.82$; 95% CI = 0.66; 0.97) and GHRQoL (PCS; $\beta = -0.275$; 95% CI = −0.42 to 0.13).

Discussion

The present study aimed to compare oral health variables, QoL between SCI patients and a healthy control group, and also to investigate the factors that are associated with OHRQoL in SCI patients. We have also analysed the effects of various factors on OHRQoL in SCI patients as the presence of impairment does not merely imply poor QoL, personal characteristics, and subjective adaptive capacity and many other factors play an important role in an individual's perception of QoL [34]. Although studies on OHRQoL and its associated factors in various other patient populations have been reported [35–37], no such studies have been reported in the SCI patients. The key findings in this study were that SCI patients had poor GHRQoL, OHRQoL, and oral hygiene practices, as well as greater caries than the healthy controls.

In addition to QoL, the level of dependence and disability were also assessed. Evaluation of functional ability is also an important outcome and marker of the effectiveness of rehabilitation [38] along with QoL [39] in SCI patients. It is assumed that approximately a third of patients with SCI have raised levels of anxiety and depression for as long as 2 years after the injury [40]. Therefore, we have also evaluated the anxiety and depression experienced by our subjects using HADS. HADS is a widely used and valid instrument to evaluate anxiety and depression in all categories of patients including those with psychological disorders and also general population [26]. For GHRQoL assessment, SF-36 was used which is one of the most widely used QoL instrument in SCI patients [41]. It was observed that subjects with SCI had lower income, with most of them being unemployed, compared to the healthy controls. Data from the USA suggest that less than one-eighth of the subjects with

Table 4
Hierarchical linear regression model depicting the factors associated with OHRQoL in spinal cord injury (SCI) patients.

Socio-demographic characteristics	Model 1			Model 2			Model 3		
	B	(SE)	LLCI/ULCI	*B*	(SE)	LLCI/ULCI	*B*	(SE)	LLCI/ULCI
Age	0.088**	0.024	0.040/0.127	0.038**	0.006	0.029/0.049	0.025**	0.006	0.014/0.035
Sex									
Male	Ref			Ref			Ref		
Female	0.011	0.247	−0.489/0.503	0.014	0.037	−0.059/0.088	0.029	0.064	−0.097/0.154
Years of education	−0.059	0.095	−0.246/0.137	−0.053	0.043	−0.028/0.143	−0.062	0.073	−0.207/ − 0.082
Clinical variables									
Time after injury	−0.087	0.317	−0.726/0.552	−0.049	0.063	−0.076/0.174	−0.031	0.079	−0.187/0.125
FIM + FAM	−0.317*	0.136	−0.591/ − 0.142	−0.308**	0.054	−0.415/ − 0.201	−0.310**	0.071	−0.459/ − 0.170
Lesion level									
Tetraplegia	Ref			Ref			Ref		
Paraplegia	−0.382*	0.089	−0.673/ − 0.084	−0.91**	0.034	−0.131/ − 0.072	−0.089**	0.012	−0.127/ − 0.077
Dry mouth									
Yes	Ref			Ref			Ref		
No	−0.621**	0.224	−1.070/ − 0.173	−0.409	0.068	−0.543/ − 0.279	−0.374**	0.139	−0.647/ − 0.101
DMFT	0.091**	0.022	0.047/0.145	0.077**	0.007	0.063/0.092	0.056**	0.018	0.020/0.091
CPI	0.274**	0.049	0.151/0.343	0.262**	0.049	0.165/0.358	0.224*	0.095	0.037/0.411
VPI	0.046	0.044	−0.039/0.132	0.069	0.046	−0.023/0.160	0.090	0.102	−0.291/0.111
GI	0.051	0.047	−0.145/0.042	0.024	0.05	−0.122/0.074	0.011	0.047	−0.103/0.081
Oral self-care behaviours									
Dental brushing									
Regular (≥2 times per day)				Ref			Ref		
Irregular (<2 times per day)				1.173**	0.218	0.744/1.601	1.23**	0.088	1.060/1.407
Dental flossing									
Regular (1 time per day)				Ref			Ref		
Irregular (<1 times per day)				0.181	0.154	−0.484/0.121	0.047	0.028	−0.103/0.009
Smoking									
No				Ref			Ref		
Yes				1.183**	0.134	0.919/ − 1.446	0.815**	0.080	0.658/0.972
General health-related quality of life									
PCS							−0.275**	0.074	−0.420/−0.130
MCS							−0.191	0.152	−0.490/0.108
Depression							0.209**	0.063	0.085/0.334
Anxiety							0.050	0.050	−0.149/0.049
R^2 change	0.389			0.258			0.175		
F value	64.626**			101.758**			126.743**		

PCS –Physical Component summary; MCS – Mental Component summary; OHIP-14 – Oral Health Impact Profile; DMFT – Decayed, missing and filled tooth index; GI – Gingival index; CPI – Community periodontal index; VPI – Visual Plaque Index; LLCI – lower limit of confidence interval; ULCI – upper limit of confidence interval.
* $p < 0.05$.
** $p < 0.01$.

SCI return to their past jobs and the unemployment in this population is found to be 10 times more than in normal individuals [42]. Further, subjects with no employment tend to have less income which was observed in our study sample.

More SCI patients reported dry mouth than the healthy individuals. This can be attributed to the side effects of medication usually taken by SCI patients [15]. In general, SCI group had poor oral hygiene practices than the healthy group. Dependency on others and the existence of systemic problems of greater importance might be detrimental factors for SCI patients to practice better oral hygiene. The SCI patient group had greater caries experience (higher overall DMFT score) than the comparative group. However, decayed teeth component in the healthy group was more than that observed in the patient group, while the treatment component of DMFT (missing and filled teeth) in the patient group was more than twofolds of that observed in the healthy group. This implies that the greater percentage of decay in the SCI group was treated (83.3%) than in the healthy group (60%) which might be due to the greater availability and accessibility of dental care for the SCI group. As anticipated, SCI group had greater plaque accumulation on teeth, gingival bleeding, and periodontal pockets than the healthy controls. Greater plaque accumulation in the SCI patients can be attributed to the poor oral hygiene practices reported by this group; routine oral hygiene practices such as toothbrushing are reliable means of plaque removal [43]. It is a well-known fact that plaque is the etiological agent for the periodontal disease [44]; greater gingival bleeding scores and higher frequency of periodontal pockets might be due to the greater levels of plaque observed in SCI patients.

SCI patients exhibited greater depression and anxiety than the comparative group in accordance with the existing literature [45]. Upon comparison of GHRQoL and OHRQoL using SF-36 and OHIP-14, respectively, subjects belonging to the SCI group reported considerably poorer GHRQoL and OHRQoL than the comparative group. This difference was in the expected direction. QoL is a subjective measure and is multidimensional; various factors that influence the perception of QoL in patients with SCI are mobility, mental health, employment, accessibility of social environment, social support, and also coping [46]. However, we did not aim to evaluate the factors associated with GHRQoL in this article as the literature on GHRQoL in SCI patients is overwhelming. Likewise, OHRQoL also depends on several biological, social, psychological, and cultural and contextual factors [47]. Age was the only sociodemographic variable associated with OHRQoL. As the individuals become older, the burden of oral disease gets accumulated which might be the rationale for older subjects perceiving greater impact of oral health on their QoL. All the oral findings had a significant negative effect on OHRQoL; subjects with dry mouth, greater caries levels, and periodontal pockets reported greater OHIP-14 scores (poor OHRQoL). It is evident that the clinical oral health status is significantly related to OHRQoL [34,48–50]. However, plaque and gingival bleeding were not related to OHRQoL. Plaque and gingival bleeding do not directly affect the

functioning of the oral cavity; therefore, the levels of plaque and gingival bleeding in an individual might not affect his/her perception of OHRQoL. However, irregular toothbrushes and smokers had poorer OHRQoL; this relationship might be mediated by the oral disease levels which are associated with toothbrushing frequency and smoking.

Physical dimension of SF-36 was related to OHRQoL. Although the physical component of SF-36 does not have a direct relevance to the oral conditions, individuals who have poorer scores in the physical component tend to be those who are physically dependent on others and thus have poorer oral hygiene practices. The influence of depression on OHRQoL might be mediated through "dry mouth"; literature suggests that depression is related to reduced salivary flow [51]. Moreover, motivation could be a possible reason for the impacts of PCS and depression on the OHRQoL of SCI patients. Depression decreases an individual's motivation of pursuing works [52], and PCS is related to an individual's mobility. Given the SCI patients have restricted mobility [13], they may have low motivation to perform the oral hygiene practices because they need to move to the restrooms. Surprisingly, other two factors (MCS and anxiety) highly related with PCS and depression had no effects on OHRQoL in our findings. The reason for nonsignificant anxiety may be attributed to the nature of anxiety. Because SCI patients find practicing oral hygiene not daunting but bothersome, it seems reasonable that depression but not anxiety has effects on their OHRQoL. In terms of the nonsignificant MCS, we attribute this slightly to the insensitivity of SF-36. The SF-36 was designed for measuring GHRQoL with its majority items on the physical component [53]. In addition, the SF-36 was found to have more measurement errors than another GHRQoL instrument [54]. Therefore, we tentatively conclude that SF-36 did not capture the entire mental part of the GHRQoL and resulted in the nonsignificant finding. However, future studies using other GHRQoL instruments are warranted to justify our rationale.

SCI patients who had lesions at the thoracic and lumbar–sacral level reported better OHRQoL scores compared to the average of all respondents. Subjects with thoracic and lumbar–sacral lesions are found to report better HRQoL than those with cervical spinal lesions [55,56]. To our knowledge, this study is the first to evaluate OHRQoL and its predictors in SCI patients. The data collected in this study were comprehensive which not only included QoL measured but also dependency and disability along with depression and anxiety. In addition, oral hygiene practices and clinical oral health status were also assessed. However, as the study was not longitudinal, the effects of the independent variables observed on OHRQoL cannot be deemed causal. Lastly, this study has the following limitations: (1) the study sample was not representative of the total SCI population of Iran which limits the external validity of our findings; (2) we have not collected data on dental visiting habits which might be a possible confounder in the regression model; (3) self-reports were used to collect data on some independent variables (e.g., smoking and oral hygiene practices) which may be biased due to social desirability. The study findings have some health policy implications and highlight the need for multi-sectoral approach as OHRQoL was predicted by general health and also psychological variables. Further, as oral health and subsequently OHRQoL were significantly affected in these patients, OHRQoL evaluation has to be made part of the comprehensive assessment of SCI treatment effectiveness. It would be worthwhile to observe the changes in OHRQoL and the effects of several factors on OHRQoL with rehabilitation in future studies on larger representative populations.

Conclusions

SCI patients had poor oral hygiene practices, greater levels of plaque, gingival bleeding, and caries than the healthy controls. Besides, more number of SCI patients have periodontal pockets and dry mouth than the comparative group. SCI patients experienced more depression and anxiety, poor physical part of the GHRQoL and OHRQoL than the control group. The factors that influenced OHRQoL in SCI patients were age, toothbrushing frequency, smoking, oral clinical status, depression, GHRQoL, and the level of lesion.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgments

We thank all patients who participated in this study.

References

[1] Furlan JC, Sakakibara BM, Miller WC, Krassioukov AV. Global incidence and prevalence of traumatic spinal cord injury. Can J Neurol Sci J Can Sci Neurol2013;40:456–64.
[2] Jazayeri SB, Beygi S, Shokraneh F, Hagen EM, Rahimi-Movaghar V. Incidence of traumatic spinal cord injury worldwide: a systematic review. Eur Spine J 2015;24:905–18.
[3] Jazayeri SB, Ataeepour M, Rabiee H, Motevalian SA, Saadat S, Vaccaro AR, et al. Prevalence of spinal cord injury in Iran: a 3-source capture-recapture study. Neuroepidemiology 2015;45:28–33.
[4] Rahimi-Movaghar V, Saadat S, Rasouli MR, Ganji S, Ghahramani M, Zarei MR, et al. Prevalence of spinal cord injury in Tehran, Iran. J Spinal Cord Med 2009;32:428–31.
[5] Burns AS, O'Connell C. The challenge of spinal cord injury care in the developing world. J Spinal Cord Med 2012;35:3–8.
[6] Rahimi-Movaghar V, Sayyah MK, Akbari H, Khorramirouz R, Rasouli MR, Moradi-Lakeh M, et al. Epidemiology of traumatic spinal cord injury in developing countries: a systematic review. Neuroepidemiology 2013;41:65–85.
[7] Eslami V, Rahimi-Movaghar V. A demographic profile of 7273 traumatic and non-traumatic spinal cord injured patients in Iran. J Inj Violence Res 2012;4 [Paper no. 47].
[8] Garshick E, Kelley A, Cohen SA, Garrison A, Tun CG, Gagnon D, et al. A prospective assessment of mortality in chronic spinal cord injury. Spinal Cord 2005;43:408–16.
[9] Osterthun R, Post MW, van Asbeck FW, van Leeuwen CM, van Koppenhagen CF. Causes of death following spinal cord injury during inpatient rehabilitation and the first five years after discharge. A Dutch cohort study. Spinal Cord 2014;52:483–8.
[10] Adriaansen JJ, van Asbeck FW, Lindeman E, van der Woude LH, de Groot S, Post MW. Secondary health conditions in persons with a spinal cord injury for at least 10 years: design of a comprehensive long-term cross-sectional study. Disabil Rehabil 2013;35:1104–10.
[11] Khazaeipour Z, Norouzi-Javidan A, Kaveh M, Khanzadeh Mehrabani F, Kazazi E, Emami-Razavi SH. Psychosocial outcomes following spinal cord injury in Iran. J Spinal Cord Med 2014;37:338–45.
[12] Myers J, Lee M, Kiratli J. Cardiovascular disease in spinal cord injury: an overview of prevalence, risk, evaluation, and management. Am J Phys Med Rehabil/Assoc Acad Physiatr 2007;86:142–52.
[13] Dijkers MP. Quality of life of individuals with spinal cord injury: a review of conceptualization, measurement, and research findings. J Rehabil Res Dev 2005;42:87–110.
[14] McRae J. Dry mouth in spinal cord injury: causes and treatment. Dent Nurs 2011;7:14–7.
[15] Yuen HK, Shotwell MS, Magruder KM, Slate EH, Salinas CF. Factors associated with oral problems among adults with spinal cord injury. J Spinal Cord Med 2009;32:408–15.
[16] Sullivan AL, Morgan CM. Beyond brushing teeth: pilot study reveals community based opportunities to promote oral care for clients with a spinal cord injury. Internet J Allied Health Sci Pract 2013;11:1–8.
[17] Stiefel DJ, Truelove EL, Persson RS, Chin MM, Mandel LS. A comparison of oral health in spinal cord injury and other disability groups. Spec Care Dent 1993;13:229–35.
[18] Thomson WM. Measuring change in dry-mouth symptoms over time using the Xerostomia Inventory. Gerodontology 2007;24:30–5.
[19] Donaghy S, Wass PJ. Interrater reliability of the Functional Assessment Measure in a brain injury rehabilitation program. Arch Phys Med Rehabil 1998;79:1231–6.
[20] Hadian MR, Yekaninejad MS, Salehin F, Razavi SH, Javidan AN, Pakpour AH, et al. Cross-cultural adaptation and reliability evaluation of Iranian version of Functional Assessment Measure in spinal cord injury patients. Neurol Neurochir Pol 2012;46:351–6.
[21] Slade GD. Derivation and validation of a short-form oral health impact profile. Community Dent Oral Epidemiol 1997;25:284–90.

[22] Ravaghi V, Farrahi-Avval N, Locker D, Underwood M. Validation of the Persian short version of the Oral Health Impact Profile (OHIP-14). Oral Health Prev Dent 2010;8:229–35.
[23] Ware Jr JE, Gandek B. Overview of the SF-36 Health Survey and the International Quality of Life Assessment (IQOLA) Project. J Clin Epidemiol 1998;51:903–12.
[24] Pakpour AH, Nourozi S, Molsted S, Harrison AP, Nourozi K, Fridlund B. Validity and reliability of short form-12 questionnaire in Iranian hemodialysis patients. Iran J Kidney Dis 2012;5:175–81.
[25] Herrmann C. International experiences with the Hospital Anxiety and Depression Scale – a review of validation data and clinical results. J Psychosom Res 1997;42:17–41.
[26] Montazeri A, Vahdaninia M, Ebrahimi M, Jarvandi S. The Hospital Anxiety and Depression Scale (HADS): translation and validation study of the Iranian version. Health Qual Life outcomes 2003;1:14.
[27] Pakpour AH, Kumar S, Fridlund B, Zimmer S. A case–control study on oral health-related quality of life in kidney disease patients undergoing haemodialysis. Clin Oral Investig 2015;19:1235–43.
[28] Klein HPC, Knutson JW. Studies on dental caries. I. Dental status and dental needs of elementary school children. Pub Health Rep 1938;53:751–65.
[29] World Health Organization. Oral health surveys, basic methods. 4th ed. Geneva: World Health Organization, Oral Health Unit; 1997.
[30] Turesky S, Gilmore ND, Glickman I. Reduced plaque formation by the chloromethyl analogue of vitamin C. J Periodontol 1970;41:41–3.
[31] Loe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. Acta Odontol Scand 1963;21:533–51.
[32] Cohen J. A power primer. Psychol Bull 1992;112:155–9.
[33] Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. J R Stat Soc: Ser B 1995;57:289–300.
[34] Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NH. Tooth loss and oral health-related quality of life: a systematic review and meta-analysis. Health Qual Life Outcomes 2010;8:126.
[35] Guzeldemir E, Toygar HU, Tasdelen B, Torun D. Oral health-related quality of life and periodontal health status in patients undergoing hemodialysis. J Am Dental Assoc (1939) 2009;140:1283–93.
[36] Massarente DB, Domaneschi C, Marques HH, Andrade SB, Goursand D, Antunes JL. Oral health-related quality of life of paediatric patients with AIDS. BMC Oral Health 2011;11:2.
[37] Schimmel M, Leemann B, Christou P, Kiliaridis S, Schnider A, Herrmann FR, et al. Oral health-related quality of life in hospitalised stroke patients. Gerodontology 2011;28:3–11.
[38] Barbetta DC, Cassemiro LC, Assis MR. The experience of using the scale of functional independence measure in individuals undergoing spinal cord injury rehabilitation in Brazil. Spinal Cord 2014;52:276–81.
[39] Whalley Hammell K. Quality of life after spinal cord injury: a meta-synthesis of qualitative findings. Spinal Cord 2007;45:124–39.
[40] Craig AR, Hancock K, Chang E, Dickson H. Immunizing against depression and anxiety after spinal cord injury. Arch Phys Med Rehabil 1998;79:375–7.
[41] Wilson JR, Hashimoto RE, Dettori JR, Fehlings MG. Spinal cord injury and quality of life: a systematic review of outcome measures. Evid Based Spine Care J 2011;2:37–44.
[42] Ottomanelli L, Lind L. Review of critical factors related to employment after spinal cord injury: implications for research and vocational services. J Spinal Cord Med 2009;32:503–31.
[43] Loe H. Oral hygiene in the prevention of caries and periodontal disease. Int Dent J 2000;50:129–39.
[44] Ribeiro Edel P, Bittencourt S, Nociti-Junior FH, Sallum EA, Sallum AW, Casati MZ. The effect of one session of supragingival plaque control on clinical and biochemical parameters of chronic periodontitis. J Appl Oral Sci: Rev FOB 2005;13:275–9.
[45] Kennedy P, Rogers BA. Anxiety and depression after spinal cord injury: a longitudinal analysis. Arch Phys Med Rehabil 2000;81:932–7.
[46] Geyh S, Ballert C, Sinnott A, Charlifue S, Catz A, D'Andrea Greve JM, et al. Quality of life after spinal cord injury: a comparison across six countries. Spinal Cord 2013;51:322–6.
[47] Sischo L, Broder HL. Oral health-related quality of life: what, why, how, and future implications. J Dent Res 2011;90:1264–70.
[48] Barbosa TS, Gaviao MB. Oral health-related quality of life in children: part II. Effects of clinical oral health status. A systematic review. Int J Dent Hyg 2008;6:100–7.
[49] Dahlstrom L, Carlsson GE. Temporomandibular disorders and oral health-related quality of life. A systematic review. Acta Odontol Scand 2010;68:80–5.
[50] Al-Harthi LS, Cullinan MP, Leichter JW, Thomson WM. The impact of periodontitis on oral health-related quality of life: a review of the evidence from observational studies. Aust Dent J 2013;58:274–7. quiz 384.
[51] D'Mello DA. Are your patients depressed? Implications for dental practice. J Mich Dent Assoc 2003;85:26–32.
[52] Austin MP, Mitchell P, Goodwin GM. Cognitive deficits in depression: possible implications for functional neuropathology. Br J Psychiatry: J Mental Sci 2001;178:200–6.
[53] Moons P, Budts W, De Geest S. Critique on the conceptualisation of quality of life: a review and evaluation of different conceptual approaches. Int J Nurs Stud 2006;43:891–901.
[54] Su CT, Ng HS, Yang AL, Lin CY. Psychometric evaluation of the Short Form 36 Health Survey (SF-36) and the World Health Organization Quality of Life Scale Brief Version (WHOQOL-BREF) for patients with schizophrenia. Psychol Assess 2014;26:980–9.
[55] Leduc BE, Lepage Y. Health-related quality of life after spinal cord injury. Disabil Rehabil 2002;24:196–202.
[56] Andresen EM, Fouts BS, Romeis JC, Brownson CA. Performance of health-related quality-of-life instruments in a spinal cord injured population. Arch Phys Med Rehabil 1999;80:877–84.